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EXPERIMENTAL STUDY ON BEHAVIOUR OF PAVER BLOCK USING CRUSHED RUBBER POWDER

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ABSTRACT

The durability and aesthetic aspects of concrete paver blocks made them as an excellent material choice for construction of driveways, walkways, retaining walls, patios and other flat outdoor spaces. Interlocking Concrete Block Pavement (ICBP) has been extensively used in a number of countries as a specialized problem-solving technique for providing pavement in areas where conventional types of construction are less durable due to many operational and environmental constraints. But now being adopted extensively in different uses where the conventional construction of pavement using hot bituminous mix or cement concrete technology is not feasible or desirable. Waste tyres in India are categorized as solid waste or hazardous waste. It is estimated that about 60% of waste tyres are disposed through unknown routes in the urban as well as rural areas. The hazards of waste tyres include air pollution associated with open burning of tyres cause odour, visual impacts, and other harmful contaminants which is the major reason for green-house effect and the consequent hazards. By considering the advantages of rubber pads, in this project the rubber powder is used as a cement replacing material in Concrete paver blocks in order to increase the strength of paver and to reduce the emitted carbon di oxide percentage while casting cement concrete paver. The optimum percentage of the rubber pad is finalized from the results of the experimental work and preferred for the pavement works. By replacing 20% of rubber powder for cement is used to obtain the compressive strength of 51Mpa and impact strength of 15 blows. Therefore by replacing the cement by rubber powder is increase the compressive and impact strength of paver block upto 50%.

Key words: compressive strength, Concrete interlocking paving blocks, Impact test, Structural concrete.

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1. INTRODUCTION

Concrete paving blocks are ideal materials on the footpaths and road for easy better and finish are studied. In this paper the behavior Of ICBP using rubber power as cement replacing materials has been carried out experiments. The impact strength of paver block by various percentage of 5%, 10%, 15%, 20% using rubber power is investigated. Test result show that the combination of adding various percentage of rubber powder in paver block gives upto 50% more impact strength than the ordinary paver block. In the paper [1] The rubber pads are used as a coarse aggregate and metal bearings are used as fine aggregate. As the result of this, The compressive and impact strength of paver have been increased upto 50%.

2. SCOPE AND OBJECTIVE

Rubber recycling is the process of recycling waste tires that are no longer suitable for use on vehicles due to wear or irreparable damage. These tires are problematic sources of waste, due to the large volume produced, the durability of the tires, and the components in the tire that are ecologically problematic. Because they are highly durable and non-biodegradable, they can consume value space in landfills. In 1990, it was estimated that over 1 billion scrap tires were in stockpiles in the India. As of 2015, only 67 million tires remain in stockpiles. From 1994 to 2010, increased the amount of tires recycle from 25% of annual discard to nearly 95%, with roughly half of the end-of-life tires used for energy, mostly in cement manufacturing.

These waste tire rubber powder can be used in the manufacturing concrete paver blocks as replacing cement in some amount .The strength of paver block can be increased as well and this is very significant. Hence adding rubber power in paver blocks is benifical as it helps to increase the impact strength and compressive strength of paver block.

3. MATERIALS USED

3.1. Cement

In manufacturing of paver blocks OPC 53 grade will be used. Ordinary Portland cement of grade 53 confirming to the Indian standard code of IS 8122:2013 has been selected. The test made on the cement are fineness of cement -90%, Standard consistency of cement – 32%, Initial setting time of cement – 30min, Final setting time of cement – 360min, Specific gravity – 2.3, Strength of cement – 38.32 N/mm2 (for 28 days)

3.2. Fine Aggregate

The aggregate has been conforming to the Indian standard code of IS: 383:1970 will be selected. The test made on the fine aggregate are specific gravity – 2.3, Bulk density of FA: loose state – 2.2kg/m3, rodded state – 1.78kg/m3.

3.3. Coarse Aggregate

The aggregate has been conforming to the Indian standard code of IS: 383:1970 will be selected. The test made on the coarse aggregate is specific gravity –2.45, Bulk density: loose state – 1.29kg/m3, rodded state – 1.48kg/m3.

3.4. Rubber Powder

These tires are problematic sources of waste, due to the large volume produced, the durability of the tires, and the components in the tire that are ecologically problematic. These waste tire rubber powder can be used in the manufacturing concrete paver blocks as replacing cement in some amount .The strength of paver block can be increased as well and this is very significant. Hence adding rubber power in paver blocks is benifical as it helps to increase the impact strength and compressive strength of paver block. The test made on the rubber are ash content – 6.50, Acetone extract – 8.50.The Fig:1 shows the curshed rubber powder of waste tyre.

Figure 1 Rubber powder

4. MIX DESIGN

The mix design is calculated according to the IS code of (IS 10262 – 2009). The proportion of the concrete mix is calculated according to this IS code. The target strength of coarse aggregate is 58.25N/mm2, Based on experience we adopt water-cement ratio as 0.40 and 0.40<0.45.Estimate water content for 100mm slump is 197 liters then content for 'sever' exposure condition is 320kg/m3and volume of fine aggregate content is 0.38 .

Table 1

	Rubber powder %	**Cement**	**Fine Aggregate**	**Coarse Aggregate**	**Water**
Per m3		350	869	1140	140
Ratio		1	2.48	3.26	0.4
1st (combo) rubber adding 0%	0	0.95	1.32	3.02	0.437
2nd (combo) rubber adding 5%	0.049	0.921	2.4	3.2	0.4
3rd (combo) rubber adding 10%	0.097	0.873	2.4	3.2	0.4
4TH (Combo) rubber adding 15%	0.1455	0.83	2.4	3.2	0.4
5th (combo) rubber adding 15%	0.194	0.776	2.4	3.2	0.4

5. PAVER PROPERTY TESTING

5.1. Slump Test

Concrete slump test is to determine the workability or consistency of concrete mix prepared at the laboratory. Concrete slump test is carried out from batch to batch to check the uniform quality of concrete. Fill the mould with the prepared concrete mix in 4 approximate equal

layers. Tamp each layer with 25 strokes of the rounded end of the tamping rod. Remove the excess concrete and level the surface. Raise the mould from the concrete immediately and slowly in vertical direction. The slump value for the concrete mix is 30cm. The figure of slump cone test is shown below (Fig:2)

Figure 2 Slump test

5.2. Compressive Test

Compressive strength of concrete depend upon the many factors such as water cement ratio, cement strength, quality of concrete material, quality of control during production of concrete. Test for compressive strength is carried out either on cube or cylinder. These specimens are tested by compression testing machine after 7 days curing or 28 days curing. Load should be applied gradually at the rate of 140 kg/cm2 per min still the specimen fails. Load at the failure divided by area of specimen gives the compressive strength of concrete. The compressive strength obtain for our paver block is shown below in the table for 7 & 28 days.

Table 2 (7 days compressive test)

Sl.no	%ofadding rubber powder	Weight kg	Area cm2	Load KN	Compressive strength N/mm2
1	0%	5.30	288	800	29.2
2	5%	5.12	288	976	35
3	10%	5.30	288	1230	38
4	15%	4.91	288	1588	47.8
5	20%	4.89	288	1800	48.9

Test for compressive strength is carried out either on cube or cylinder. These specimens are tested by compression testing machine after 7 days curing or 28 days curing. Load should be applied gradually at the rate of 140 kg/cm2 per min still the specimen fails. Load at the failure divided by area of specimen gives the compressive strength of concrete. The compressive strength obtain for our paver block is shown below in the table for 28 days.

Table 3 (28 days compressive test)

Sl.no	Ratio of adding rubber powder	Weight kg	Area cm2	Load KN	Compressive strength N/mm2
1	0%	5.43	288	946	31
2	5%	5.20	288	1230	39.6
3	10%	5.13	288	1469	46
4	15%	5.15	288	1520	49.2
5	20%	4.94	288	1601	51

Figure 3 Compressive Test

5.3. Impact Test

It consist of aggregate impact testing machine. The weight of hammer in aggregate impact testing machine is 14kg. During testing, steel plate was used at top surface of the paver block. Blows are applied on each paver blocks till failure occurs. The impact results for 7 & 28 days of paver blocks are tabulated below.

Table 4 (7 days Impact test)

Sl.no	Number of Pavers	Weight of paver	Impact value
1	0%	5.30	5
2	5%	5.12	7
3	10%	5.30	10
4	15%	4.91	9
5	20%	4.89	8

Table 5 (28 days Impact test)

Sl.no	Number of Pavers	Weight of paver	Impact value
1	0%	5.43	6
2	5%	5.20	10
3	10%	5.13	12
4	15%	5.15	14
5	20%	4.94	15

6. RESULT AND DISCUSSION

The compressive strength of standard paver block is 31KN/mm2.The strength obtained for 1st combo for 7days is 29.2Mpa. And the combination of replacing 2ndcomboof crushed rubber powder for cement to obtain compressive strength of 35Mpa for 7daysie, 19% increment from the standard normal paver blocks. The combination of replacing 3rdcombo of crushed rubber powder for cement to obtain compressive strength of 38Mpa for 7days ie.., 30% increment from the standard normal paver blocks. The combination of replacing 4thcombo of crushed rubber powder for cement to obtain compressive strength of 47.8Mpa for 7 daysie., 40% increment from the standard normal paver block. The combination of replacing 5th combo of crushed rubber powder for cement to obtain compressive strength of 48.9Mpa for 7 daysie., 50% increment from the standard normal paver blocks. The compressive strength of standard paver block is 31KN/mm2.The strength obtained for 1st combo for 28days is 31Mpa. And the combination of replacing 2nd combo of crushed rubber powder for cement to obtain compressive strength of 39.6Mpa for 28 daysie., 27% increment from the standard normal

paver blocks. The combination of replacing 3rdcombo of crushed rubber powder for cement to obtain compressive strength of 46Mpa for 28days ie.., 34% increment from the standard normal paver blocks. The combination of replacing 4th combo of crushed rubber powder for cement to obtain compressive strength of 49.2Mpa for 28 daysie., 41% increment from the standard normal paver block. The combination of replacing 5th combo of crushed rubber powder for cement to obtain compressive strength of 51Mpa for 28 days ie.., 50% increment from the standard normal paver blocks.

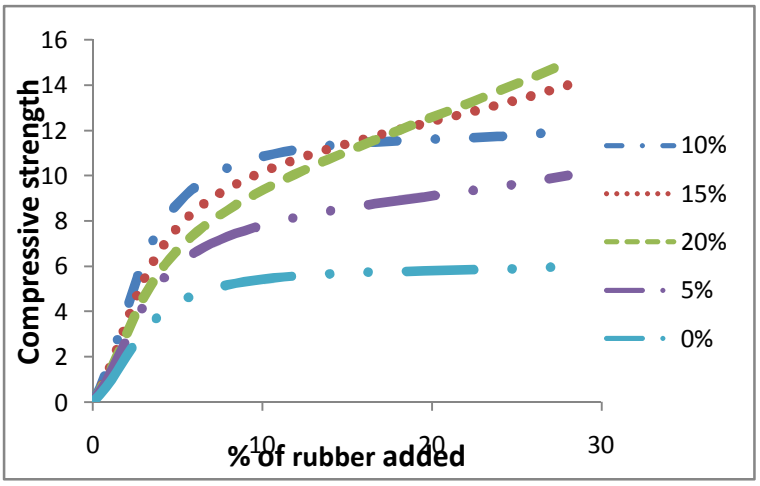

Figure 4 Comparison of compressive strength with various % of rubber

The Impact strength of standard paver block is 10 blows. The strength obtained for 1st combo for 7days is 5 blows and 28days is 6 blows. And the combination of replacing 2nd combo of crushed rubber powder for cement to obtain impact strength of 7 blows for 7days and 10 blows for 28days. The combination of replacing 3rd combo of crushed rubber powder for cement to obtain impact strength of 10 blows for 7days and 12blows for 28days. The combination of replacing 4th combo of crushed rubber powder for cement to obtain impact strength of 9 blows for 7days and 14 blows for 28days. The combination of replacing 5th combo of crushed rubber powder for cement to obtain impact strength of 8 blows for 7days and 15 blows for 28days.

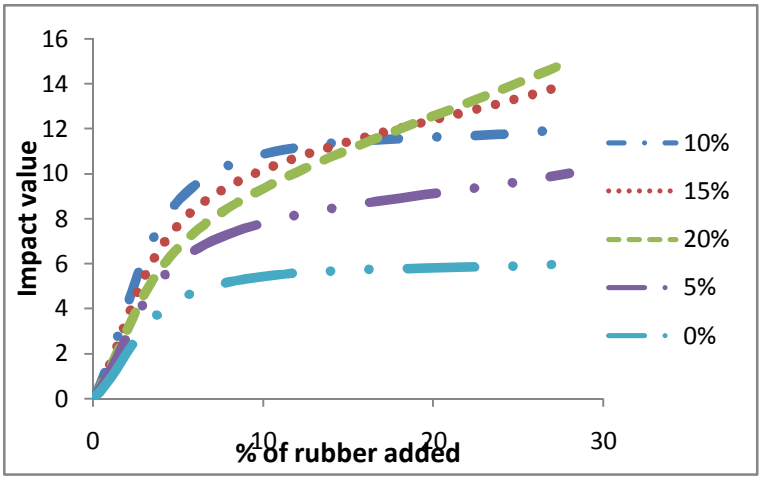

Figure 5 Comparison of Impact value with various % of rubber

7. SUMMARY & CONCLUSION

From the earlier studies it is found that the rubber is added to increase the impact and compressive strength of the paver block. In this paper, the waste tyre crushed rubber powder is used to increase the impact and compressive strength of the paver block.

The compressive strength of standard paver block is 31KN/mm2.The strength obtained for 1st combo for 7days is 29.2Mpa. And the combination of replacing 2nd combo of crushed rubber powder for cement to obtain compressive strength of 35Mpa for 7days ie., 19% increment from the standard normal paver blocks. The combination of replacing 3rdcombo of crushed rubber powder for cement to obtain compressive strength of 38Mpa for 7days ie.., 30% increment from the standard normal paver blocks. The combination of replacing 4th combo of crushed rubber powder for cement to obtain compressive strength of 47.8Mpa for 7 days ie.., 40% increment from the standard normal paver block. The combination of replacing 5th combo of crushed rubber powder for cement to obtain compressive strength of 48.9Mpa for 7 days ie.., 50% increment from the standard normal paver blocks. The compressive strength of standard paver block is 31KN/mm2.The strength obtained for 1st combo for 28days is 31Mpa. And the combination of replacing 2nd combo of crushed rubber powder for cement to obtain compressive strength of 39.6Mpa for 28days ie., 27% increment from the standard normal paver blocks. The combination of replacing 3rdcombo of crushed rubber powder for cement to obtain compressive strength of 46Mpa for 28days ie.., 34% increment from the standard normal paver blocks. The combination of replacing 4th combo of crushed rubber powder for cement to obtain compressive strength of 49.2Mpa for 28 days ie.., 41% increment from the standard normal paver block. The combination of replacing 5th combo of crushed rubber powder for cement to obtain compressive strength of 51Mpa for 28 days ie.., 50% increment from the standard normal paver blocks. The Impact strength of standard paver block is 10 blows. The strength obtained for 1st combo for 7days is 5 blows and 28days is 6 blows. And the combination of replacing 2nd combo of crushed rubber powder for cement to obtain impact strength of 7 blows for 7days and 10 blows for 28days. The combination of replacing 3rd combo of crushed rubber powder for cement to obtain impact strength of 10 blows for 7days and 12 blows for 28days. The combination of replacing 4th combo of crushed rubber powder for cement to obtain impact strength of 9 blows for 7days and 14 blows for 28days. The combination of replacing 5th combo of crushed rubber powder for cement to obtain impact strength of 8 blows for 7days and 15 blows for 28days. Therefore by replacing the cement by rubber powder is increase the compressive and impact strength of paver block upto 50%.

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